



# THE CASE FOR GEARED ELECTRIC PROPULSION

Power transmissions and propulsion systems are ubiquitous throughout the world. A sustainable approach to these technologies will therefore have a major impact on their environmental footprint.

Many developments and improvements have been seen in this field over the years, and new ideas show up regularly. Some of them are more reliable and efficient than others.

Stadt has been a part of these developments over many years, and the 5 generation of drive technology – the No-Loss drive – stands out as an obvious solution when it comes to sustainability. The technology also offers high efficiency, reliability and safety as well as stealth features that ensure that there is no interference with sensitive electronic equipment, and an absolute minimum of acoustic noise from electric motors and drives. It is a patented technology, and has received a number of awards.

These days, many claim that the use of gearboxes is obsolete, but this is far from correct. For example, popular electric cars like the Nissan Leaf and Tesla's models take advantage of a gearbox. This is a single shift gearbox, which is not obvious to the driver as there is no gear shift. But the gearbox is there, between the electric motor and the wheels. Typically these gearboxes have a gear ratio of 10:1, enabling the electric motor to run at 18,000 rpm or thereabouts at full speed.

People may be misled, even by engineers in the industry, saying that there is no gearbox. It may not be a standard gearbox, but there is still a gearbox involved. Even the world's fastest supercars – electric EV and others – use a gearbox in their transmission.

The electric motor, the gearbox and the AC drive must be evaluated as one unit together when it comes to questions such

Reports that the gearbox is obsolete are overstated says Hallvard Lidset Slettevoll, founder and chief executive of electric propulsion systems specialist Stadt

as power, torque, weight, volume, efficiency, reliability and lifetime.

The use of permanent magnet motors does not make any difference here, as many tend to believe. The Tesla car, for instance, successfully uses a robust induction AC motor with gearbox. Since it can operate over a wide speed range from zero to 18,000 rpm, the motor and gear arrangement becomes very compact and has a low weight.

In ship applications the electric motor will have a maximum rpm of 1,800 or less, and a gear ratio of 6:1. This provides a set-up that is much more compact and far less heavy than if it was run at 300 rpm.

AC induction motors are easy to manufacture and maintain, and do not require rear and expensive magnetic materials. They have an efficiency of about 97.5 per cent at full load.

The nature of rotating machines and the laws of physics tell us that a gearless solution that uses an electric motor alone will not be able to deliver the required power and torque as efficiently as a geared solution.

There are many manufacturers of gearboxes in the world, and there are

many different designs. In general, a simple gearbox is a reliable and very efficient device. The power losses amount to somewhere between 1 and 2 per cent, depending on the gear ratio, teeth arrangement, bearings and lubricant.

A gearbox can also give operational advantages such as increased redundancy by using several electric motors with one gearbox. Separate clutches can engage the individual motors. Ships with turbine driven propulsion have always used gearboxes on the propulsion, because of the high turbine speed.

In the Stadt No-Loss electric propulsion drive system, the gearbox is also combined with the use of controllable pitch propellers. Very often the pitch controller is located in the gearbox as well.

So there are a number of reasons why all these applications are using the gearbox, but the most important is increased torque and power, space savings and weight savings.

How much is gained by using the gearbox varies from case to case.

Stadt feeds its AC propulsion motors with sinusoidal voltage and power, eliminating the torque pulsation that is found in pulse width modulation type motor drives. Because of this Stadt can provide a stealth solution that has minimal vibrations and acoustic motor noise, and is free from electromagnetic interference.

When properly designed, the gearbox, too, can be operated at a very low noise level, as it is on a submarine.

Field experiments over several years combined with simulations have shown that the Stadt No-Loss drive will gain 5 to 6 per cent in fuel savings per year compared with traditional AC drive solutions based on non-sinusoidal drives, such as pulse width modulation, direct torque control, 6, 12, or 24 pulse, active front end or DC grid based. [MP](http://www.mpropulsion.com)